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(54) Abstract Title
Providing handoff in a CDMA communications system

(57) In the preferred embodiment, a non-full rate frame of IS-95 forward channel is squeezed into a shorter frame in order for the mobile terminal 100 to monitor other frequencies with a single receiver. Modulated symbols of non-full rate frame are transmitted with reduced repetition maintaining the total symbol energy. Generally, for 1/n (n=2,4,8) transmission, 1/m (m≥n) rate frame is transmitted with m/n times repetition at n/m times power level of the full rate frame. The system may use rate limitation to generate a non-full rate frame. For transmission positioning assignment, a starting position of the transmitted symbols for each user may be randomized by a user long code to minimize the intra-cell interference. For intensive frequency scanning and synchronization, the transmission limitation can be assigned for continuous or successive frames of some interval. For 1/n (n=2,4,8) continuous or successive transmission limitation, the starting position of the transmitted symbols are staggered by 1/n frame time in each 20ms frame. If there is no part of the frame to be staggered, the starting position is the beginning of the frame. Such implementation minimizes guard time overhead for frequency switching and PN resynchronization.

GB 2 331 205 A

The references to figure 5H of the drawings in the printed specification are tobe treated as omitted under Section 15(2) or (3) of the Patents Act 1977

FIG.1A

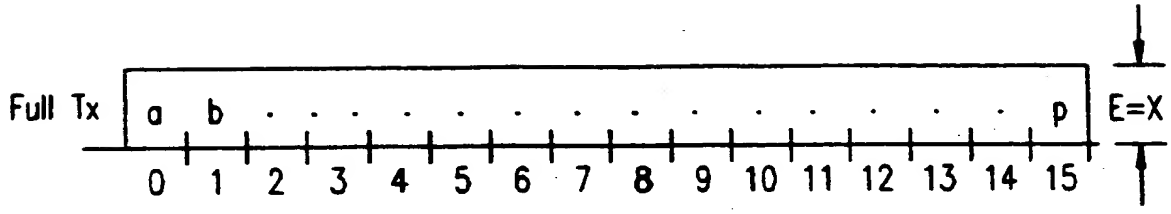


FIG.1B

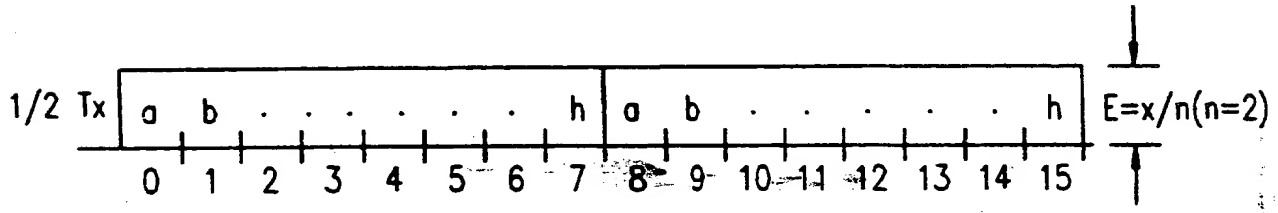


FIG.1C

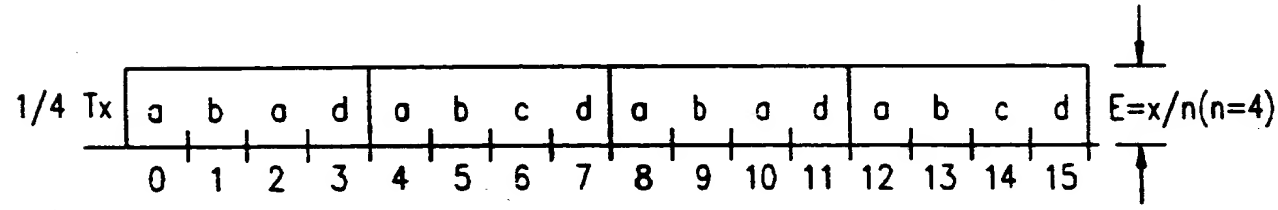


FIG.1D

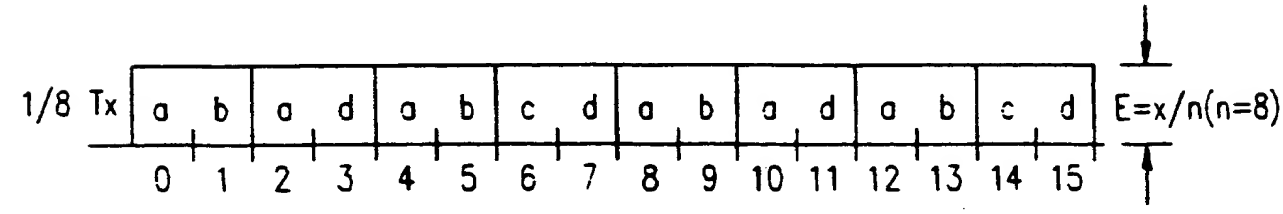


FIG.2A

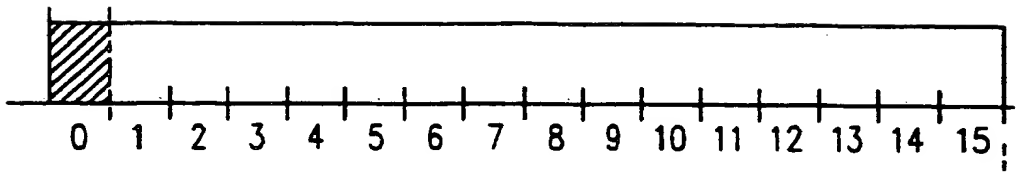


FIG.2B

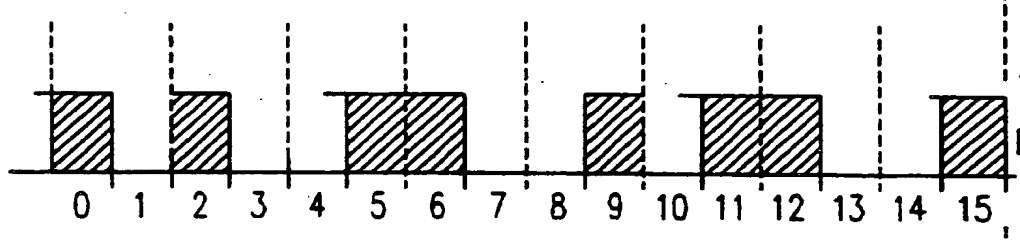


FIG.2C

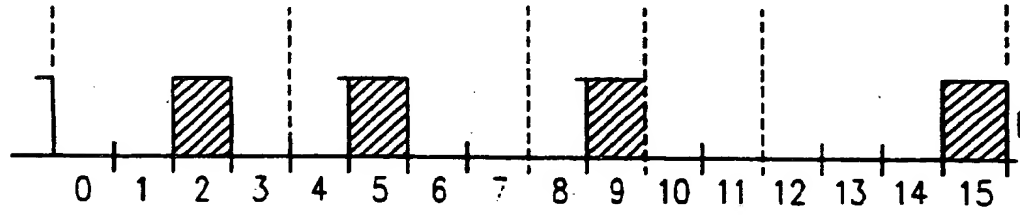


FIG.2D

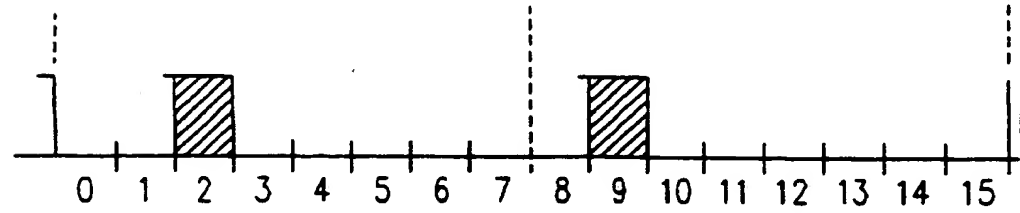


FIG.3

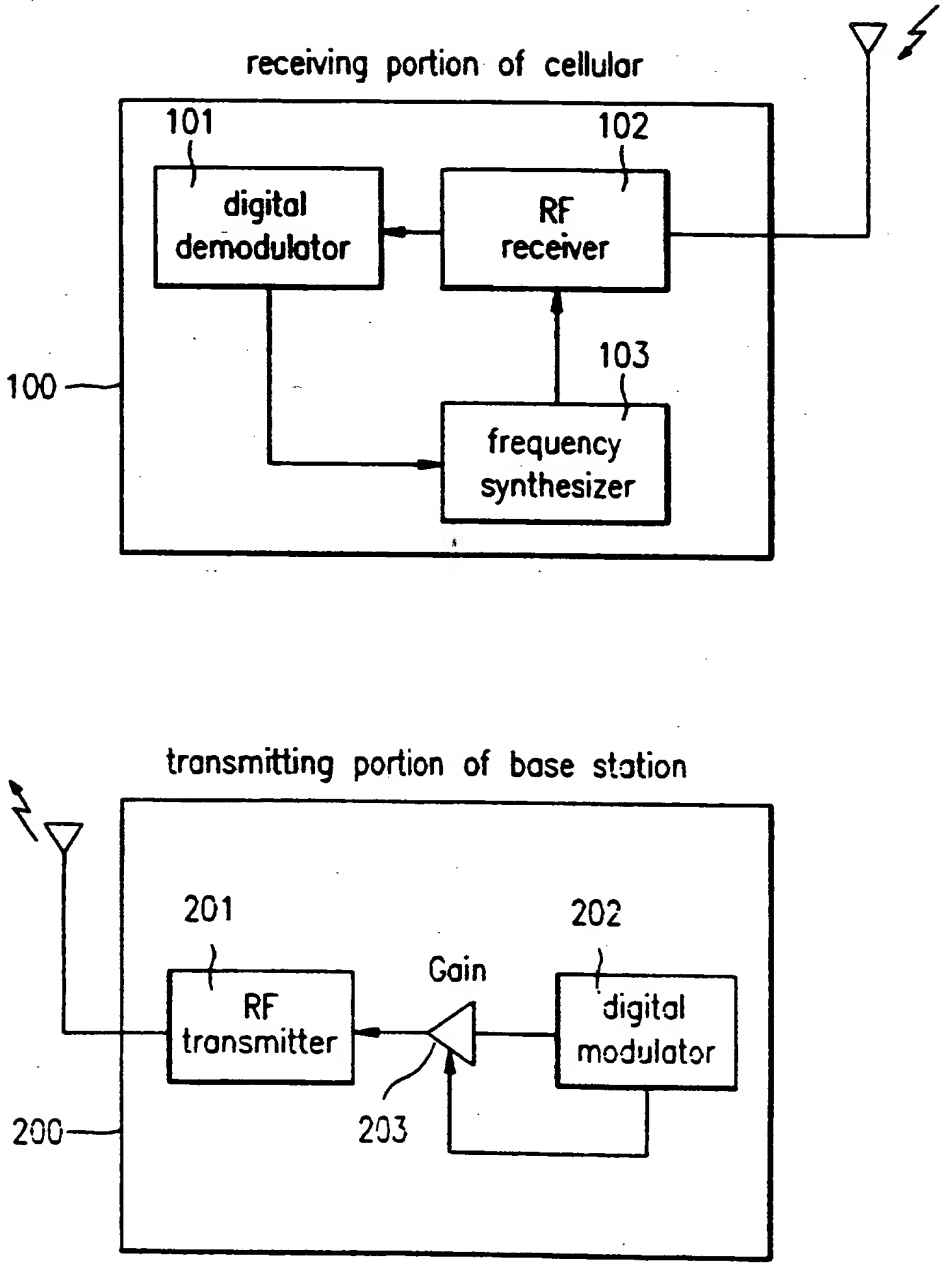

receiving portion of cellular
101
102
digital demodulator
RF receiver
103
100
frequency synthesizer
transmitting portion of base station
201
202
Gain
RF transmitter
digital modulator
200
203

FIG.4A

FIG.4B

FIG.4C

FIG.4D

FIG.4E

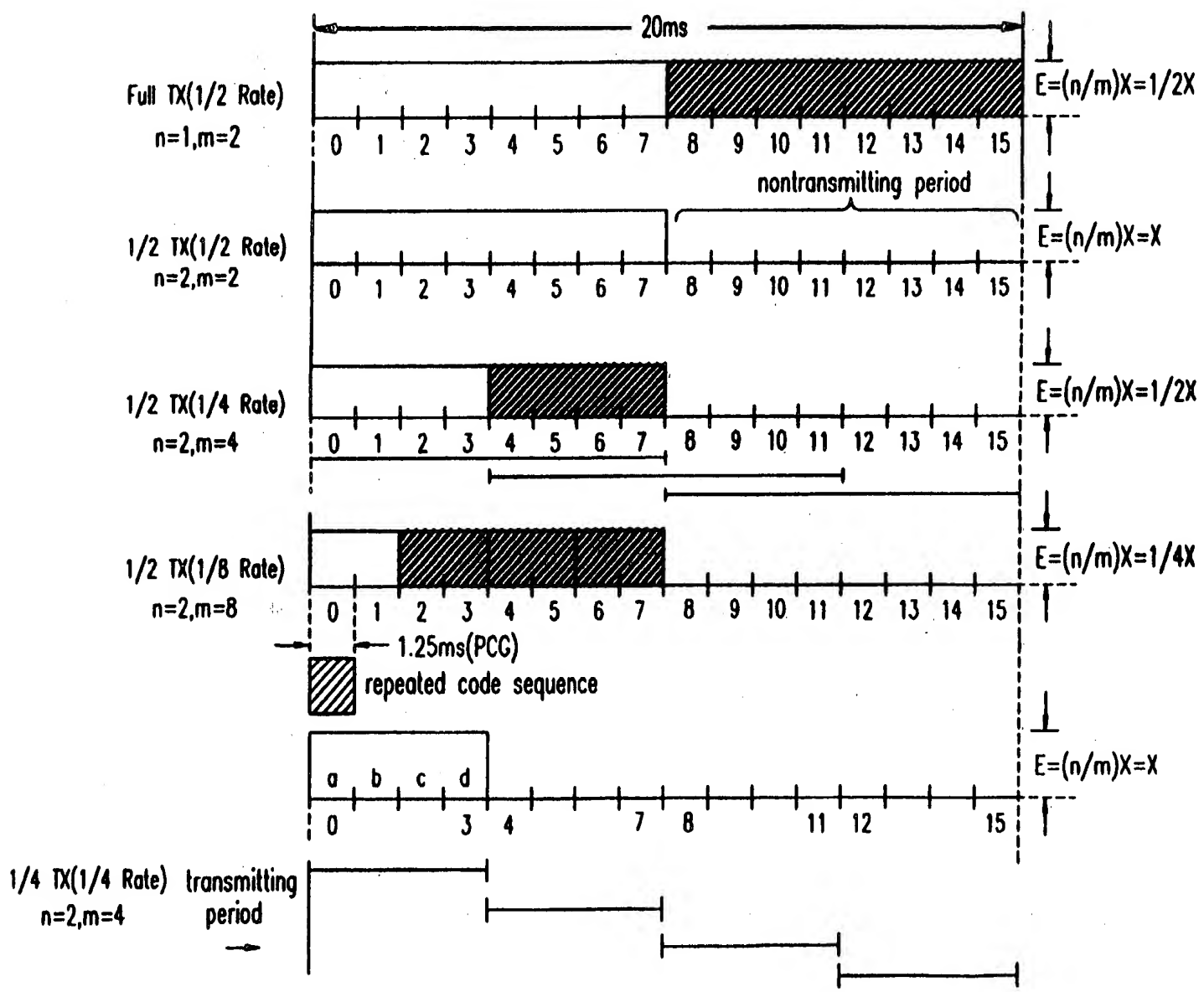


FIG.4F

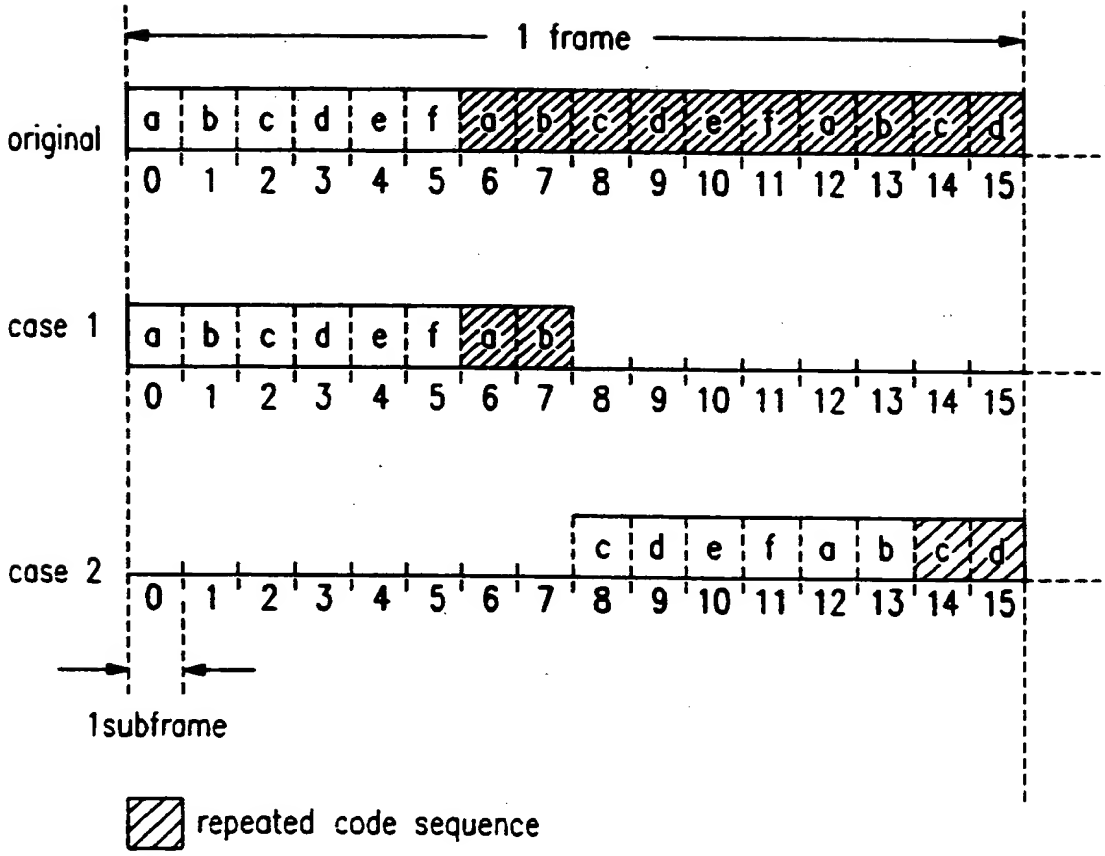

1 frame
original
a b c d e f a b c d e f a b c d
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
case 1
a b c d e f a b
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
case 2
c d e f a b c d
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
1subframe
repeated code sequence

FIG.4G

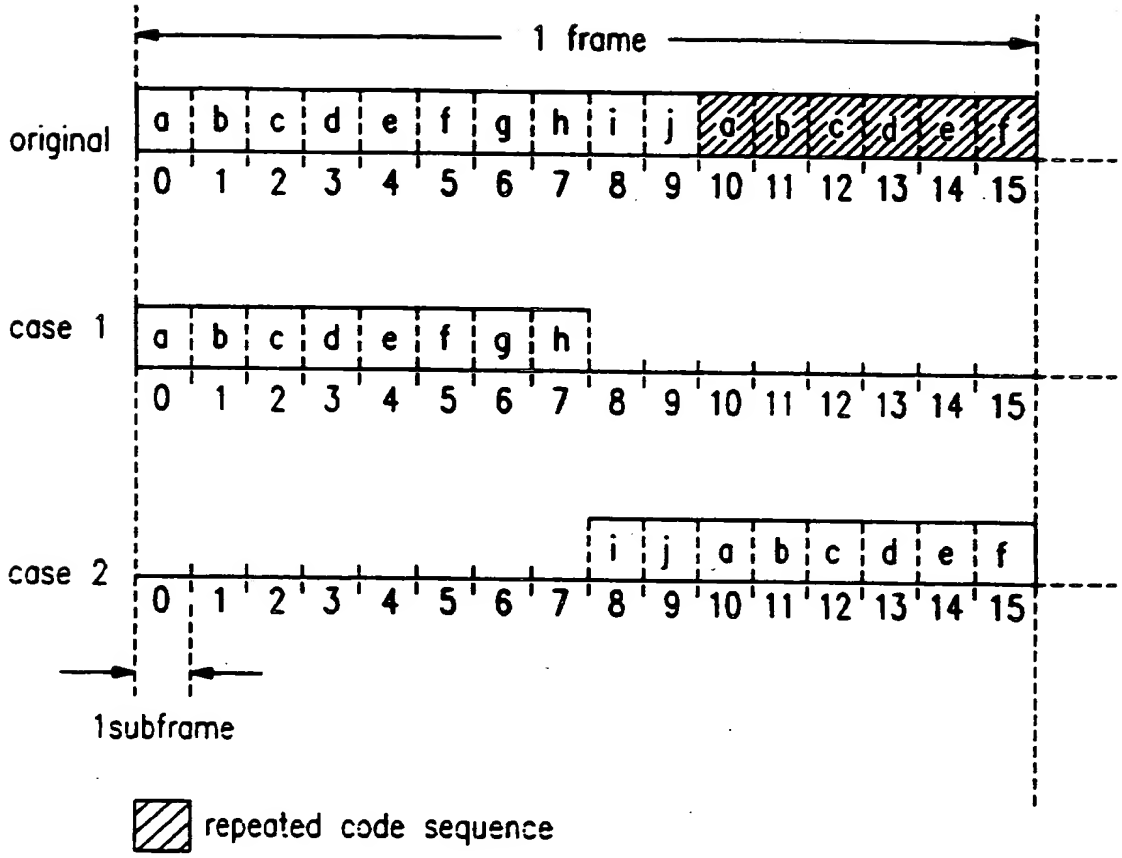

1 frame
original
a b c d e f g h i j a b c d e f
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
case 1
a b c d e f g h
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
case 2
i j a b c d e f
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
1subframe
repeated code sequence

FIG.4H

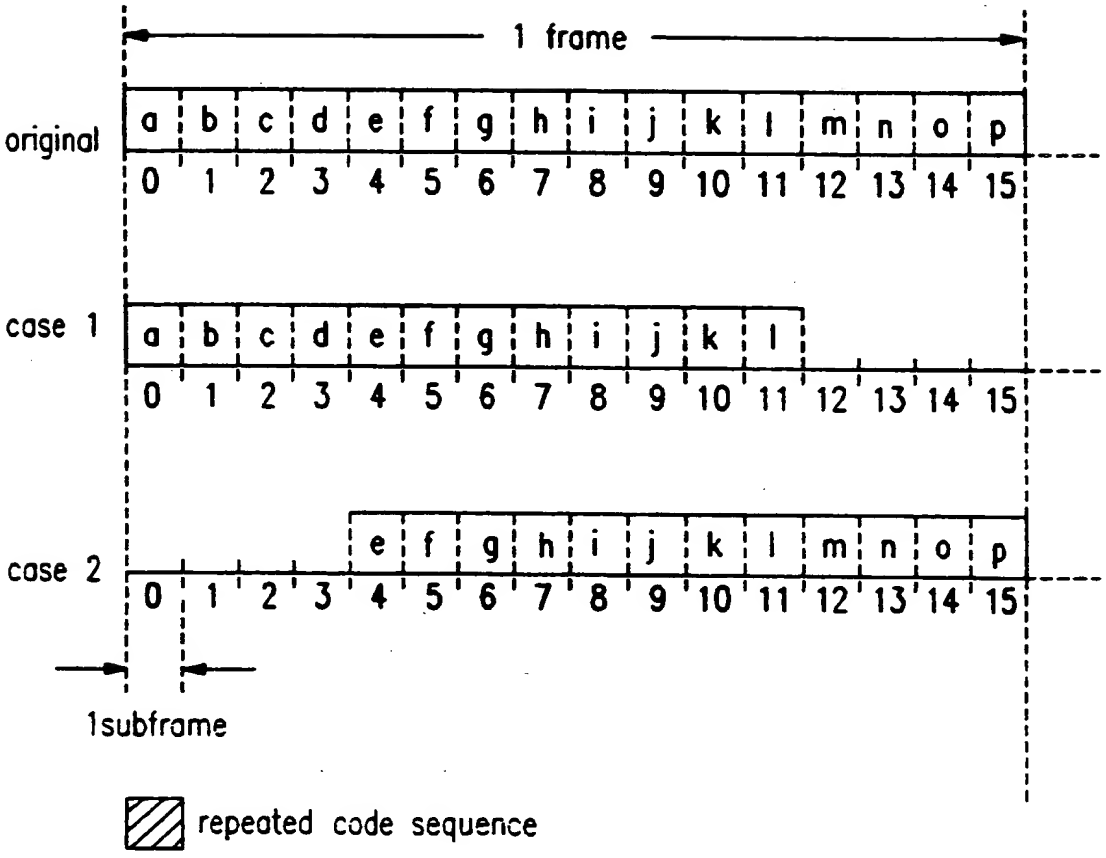
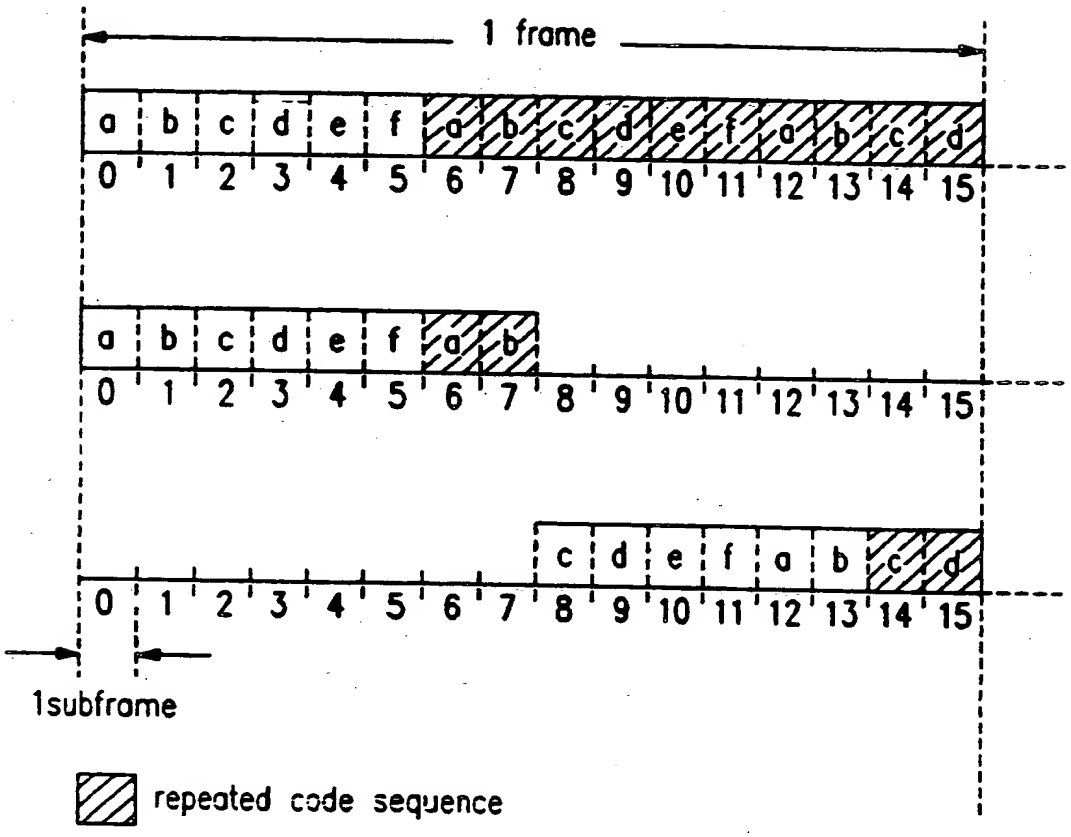
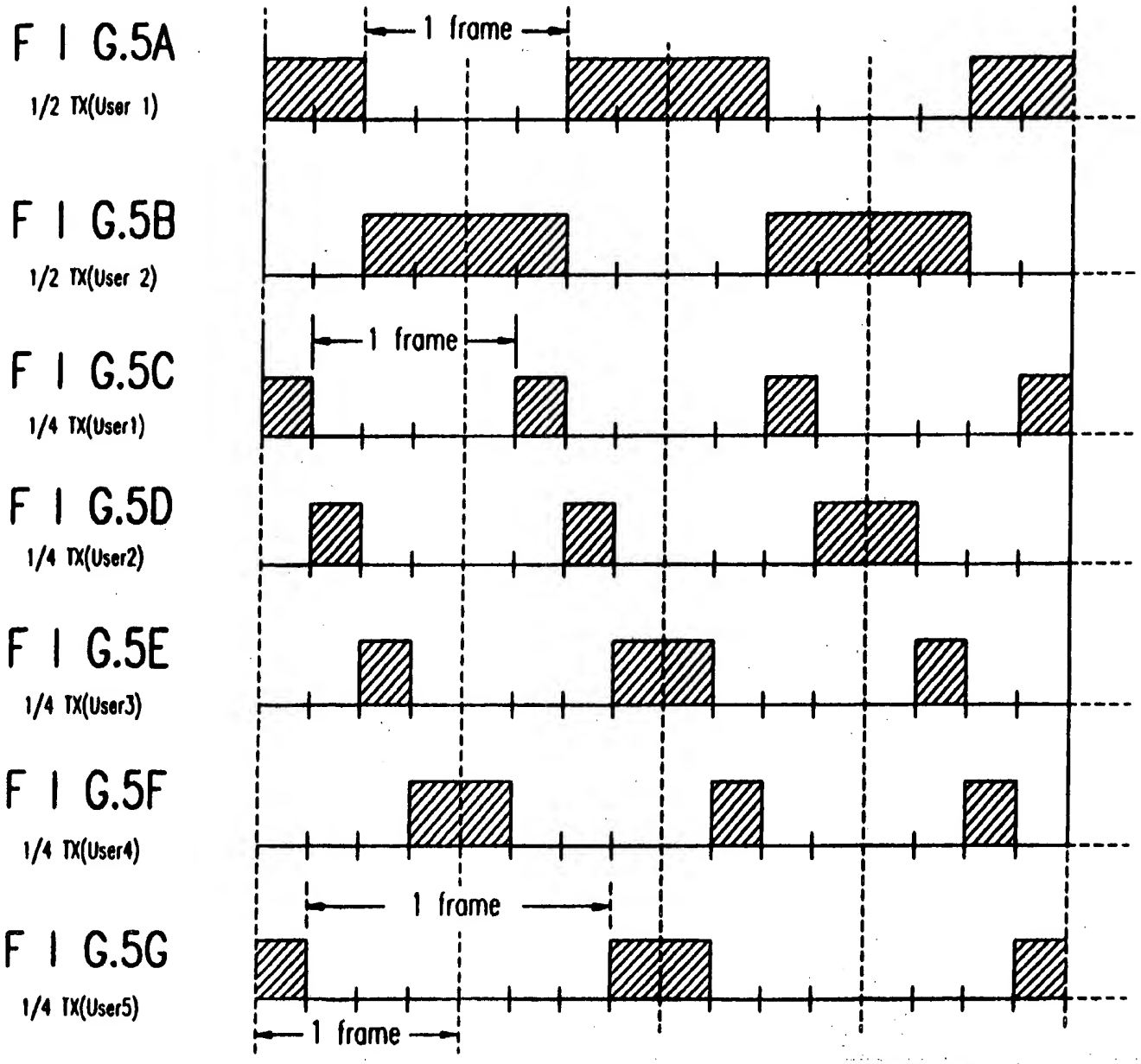

1 frame
original
a b c d e f g h i j k l m n o p
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
case 1
a b c d e f g h i j k l
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
case 2
e f g h i j k l m n o p
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
1subframe
repeated code sequence

FIG.5


1 frame
a b c d e f a b c d e f a b c d
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
a b c d e f a b
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
c d e f a b c d
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
1subframe
repeated code sequence


F I G.5A
1/2 TX(User 1)
F I G.5B
1/2 TX(User 2)
F I G.5C
1/4 TX(User1)
F I G.5D
1/4 TX(User2)
F I G.5E
1/4 TX(User3)
F I G.5F
1/4 TX(User4)
F I G.5G
1/4 TX(User5)
1 frame
1 frame
1 frame
1 frame

METHOD AND SYSTEM FOR PROVIDING INTER-FREQUENCY HANDOFF IN A TELEPHONE SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a telephone system, and more particularly, to a method for controlling an inter-frequency handoff in a code division multiple access (CDMA) cellular telephone system.

2. Background of the Related Art

Generally, a cellular telephone system includes a service area which is divided into a plurality of cells. Each cell provides many mobile terminals with a radio communication service through a base station. To maintain high quality communication when the mobile terminal moves between cells, a handoff, which changes a communication link or channel with one base station to another base station, must be timely established. Therefore, the mobile terminal has to be able to measure the quality of signals from other peripheral base stations during communication, and the base station system is provided with the quality of signal information to timely perform the handoff. Such a hand off is referred to as a mobile-assisted handoff.

In particular, the CDMA system can perform the communication

while using the same frequency and varying an offset of a code. The CDMA system has a first digital receiver, which is referred to a searcher for searching a different CDMA signal of the same frequency, and a second digital receiver for demodulating the data. Accordingly, the mobile terminal can measure the quality of a different base station signal of the same frequency during the communication.

The capacity of the mobile terminals in the cellular telephone system may be increased by reducing the size of the cell to increase the number of the cells within the service area. However, if the size of the cell is reduced, the handoff is too quickly generated when moving at a high speed. Hence, the base station has difficulty in properly processing the handoff.

Accordingly, when the terminal is moving at a high-speed, a hierarchical cell structure or a layered cell structure is used, where a macro-cell of a larger size is placed upon a micro-cell of smaller size. In this cell structure, the handoff between the micro-cell and macro-cell according to a moving speed of the terminal, as well as the handoff between macro-cells, has to be provided.

In the hierarchical cell structure, the force of the base station signal of the macro-cell may be much larger than that of the base station signal of the micro-cell, and it is difficult to use together the frequencies of the macro-cell and the micro-cell

in the CDMA system. To provide the hierarchical cell structure in the CDMA system, an inter-frequency handoff between base stations has to be provided.

To perform the inter-frequency mobile-assisted handoff, the mobile terminal has to be able to receive the base station signal of different frequency during the communication and therefore, it has to be provided with an additional radio frequency RF receiver, or alternatively, the mobile terminal has to use one RF receiver in a time-division multiplexing (TDM) method for receiving the signal of a different frequency.

In the CDMA method, the transmission rate of the data can be varied in multilevel, and the capacity of the entire channel can be increased by reducing an interference between different channels, which use the same frequency as the transmission rate is reduced. For example, voice data has an information amount variable with the time, and half of the communication is used for listening, i.e., receiving voice data, and the rest is used for speaking, i.e., transmitting voice data. If a variable rate transmission is used, a fifty percent or more increase in capacity may be produced.

The above-mentioned related CDMA cellular telephone system continuously transmits a forward signal from the base station toward the mobile terminal, the mobile terminal must have two or more RF receivers for receiving the base station signal of different frequencies during the communication. However, such an

increase in components is undesirable since the trend is to miniaturize the mobile terminal.

In the CDMA system, the time period where the mobile terminal breaks a part of reception signal and receives the signal of the different frequency may be used for providing the inter-frequency handoff with one RF receiver. However, such a method may cause the deterioration of the communication quality and the communication may be cut off as the required signaling data is not received.

For large capacity and various other environments, a layered-cell structure having micro-cells and macro-cells are important. However, a layered-cell structure on the same frequency causes various problems, including cocktail party effect, egg phenomenon, etc. Accordingly, there is a need for telecommunication systems to support inter-frequency (mobile-assisted) handoff for layered-cell structure on different frequencies.

The related scheme for inter-frequency handoff has various disadvantages. For example, a dual transceiver increases the cost and size of the mobile terminal. Further, IS-95B signaling enhancement lacks full enhancement due to no support of the physical layer. Moreover, in the competing standard scheme of compressed mode, the transmission frame is squeezed into a short frame by a variable processing gain (ETSI) or by multi-modulation scheme (NTT DoCoMo).

SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to substantially obviate the problems of the related art.

An object of the present invention is to provide a method for providing inter-frequency handoff in a code division multiple access cellular telephone system capable of maintaining an excellent communication quality.

Another object of the present invention is to rapidly establish an inter-frequency handoff between a mobile terminal and a peripheral base station as the mobile terminal searches a frequency of the other base station or transmits searched information.

A further object of the present invention is to allow inter-frequency handoff without using dual transceivers.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, a method for providing an inter-frequency handoff in a code division multiple access cellular telephone system comprises the steps of: forming a non-transmitting period in a transmission frame by controlling the repeat times of a transmission symbol in a frame and a position or form of a transmitting period with a variable rate characteristic of a transmission signal; controlling an energy transmission level of the signal reconstructed through the aforesaid step in inverse proportion to the repeat times to

transmit it; and searching a base station signal of a different frequency through a period where a signal of the frame transmitted through the aforesaid step is not transmitted, or transmitting a signal to the base station of the different frequency, by a mobile terminal.

The present invention can be achieved in parts or in a whole by a method of performing a handoff in a telephone system comprising the steps of: modulating a frequency band to a prescribed energy transmission level of a frame unit by controlling repeat times of a symbol; inserting a searching period into the modulated frame to reconstruct the modulated frame as a transmission frame; and searching a frequency information of a station with the transmission frame to perform a handoff.

The present invention can be achieved in parts or in a whole by a method for providing a handoff in a telephone system comprising the steps of: modulating a band into a modulated frame having a repeated frame period by varying an energy transmission level based on a full rate frame; forming a non-transmitting period to the modulated frame and reconstructing a repeat transmission frame by controlling a number of repetition of the energy transmission level; and searching frequency information of a peripheral station with the transmission frame to perform a handoff and transmitting the searched information to a transmitter of a base station.

The present invention can be achieved in parts or in a whole by a method for providing a handoff in a telephone system comprising the steps of: forming a non-transmitting period in a transmission frame by controlling a number of repetitions of a transmission symbol in a frame and at least one of a position and form of a transmitting period with a variable rate characteristic of the transmission frame; controlling an energy transmission level of the transmission symbol by an inverse proportion of the number of repetitions; and searching a base station signal of a different frequency during the non-transmitting period; or transmitting a signal to the base station of the different frequency, by a mobile terminal.

The present invention can be achieved in parts or in a whole by a telephone system comprising: a station that modulates a frequency band into a transmission frame having an energy level based on an inverse proportion of a number of repetitions of a transmission symbol, and at least one of a position and form of a transmitting period with a variable rate characteristic of the transmission frame, the station forming a non-transmitting period based on the number of repetitions as a searching period; and a terminal that searches frequency information during the searching period and transmits the searched frequency information to the station.

Additional features and advantages of the invention will be

set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in detail with reference to the following drawings in which like reference numerals refer to like elements wherein:

Figs. 1A to 1D are transmission timing diagrams applied to a forward link or channel of a variable rate CDMA system;

Figs. 2A to 2D are transmission timing diagrams applied to a reverse link or channel of a variable rate CDMA system;

Fig. 3 is a block diagram showing a preferred embodiment of the CDMA cellular telephone system;

Figs. 4A to 4H are transmission timing diagrams applied to a method for providing an inter-frequency handoff in accordance with a preferred embodiment of the present invention; and

Figs. 5A to 5F are timing diagrams showing a continuous frequency searching period upon a control of the inter-frequency handoff in accordance with one of the preferred embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figs. 1A to 1D and Figs. 2A to 2D, respectively, show a timing diagram in accordance with a signal transmission of a variable rate used in a code division multiple access CDMA cellular telephone system of "IS-95" style (see U.S. Patent No. 5,416,797). Figs. 1A to 1D are applied to a method of varying transmission energy, and Figs. 2A to 2D is applied to a method varying the transmission time.

In other words, Figs. 1A to 1D are signal transmission timing diagrams of a forward link or channel transmitted from a base station to a mobile terminal, and Figs. 2A to 2D are signal transmission timing diagrams of a reverse link or channel transmitted from the mobile terminal to the base station.

Generally, in the CDMA communication system, all base stations use the same frequency. The mobile terminal uses a RAKE receiver and a searcher for measuring radio signals of the different base stations during communication.

A transmission frame of the voice information transmitted from the base station is divided into sixteen subframes, and is transmitted to the mobile terminal as a variable rate of four levels, such as a full rate (Fig. 1A), a half (1/2) rate (Fig. 1B), a quarter (1/4) rate (Fig. 1C) and an eighth (1/8) rate (Fig. 1D). Then, if the variable rate is reduced to n (herein, n is 2, 4 and 8), the number of bit per the frame of the transmission data is

accordingly reduced and therefore, transmission data may be transmitted by a repetition of n times.

If a transmission party repeatedly transmits the signals, a reception party combines the repeated signals to achieve time diversity. The signal is divided according to the time to be transmitted and thereby, the transmission signal can be demodulated by the rest of the signals although parts of the repeated signals are broken. The transmission process is repeatedly performed after signals of the 1/n frame length are all transmitted so that the transmission signal may be transmitted from a maximum distance for maximizing the effect of the time diversity.

With reference to Figs. 2A to 2D, the transmission frame of voice information transmitted from the base station is distributed into set random patterns in a transmission/reception period to be transmitted. For example, in case of Fig. 2A, all frames are transmitted. In case of 1/2 rate shown in Fig. 2B, any one of two subframes is transmitted, and in case of 1/4 rate of Fig. 2C, any one of four subframes is transmitted. In case of 1/8 rate of Fig. 2D, any one of eight subframes is selected to be transmitted to the receiver of the terminal in the random pattern.

Fig. 3 is a block diagram showing a transceiver applied to the method of controlling the inter-frequency handoff in the CDMA cellular telephone system in accordance with the present invention. With reference to Fig. 3, an inter-frequency handoff transceiver in

the CDMA cellular telephone system is comprised of a receiving portion 100 of the mobile terminal and a transmitting portion 200 of a base station.

The receiving portion 100 of the mobile terminal includes an RF receiver 102 receiving a radio signal selected in the radio signals transmitted from the transmitting portion 200 of the base station; a digital demodulator 101 demodulating the radio signal to an original signal; and a frequency mixer 103 mixing frequency so that the RF receiver 102 may selectively receive any one of the radio signals.

The transmitting portion 200 of the base station includes a digital modulator 202 forming the transmission frame of data in a frame unit and modulating each bit to a modulation symbol; a gain controller 203 controlling an energy level of the modulated transmission symbol by n/m; and an RF transmitter 201 varying and amplifying a frequency of the gain controlled radio signal to transmit it to an outside through an antenna.

In the preferred embodiment, a non-full rate frame of IS-95 forward channel is squeezed into a shorter frame in order for the mobile terminal 100 to monitor other frequencies with a single receiver. Modulated symbols of non-full rate frame are transmitted with reduced repetition maintaining the total symbol energy. Generally, for 1/n (n=2,4,8) transmission, 1/m (m?n) rate frame is transmitted with m/n times repetition at n/m times power level of

the full rate frame. The system may use rate limitation to generate a non-full rate frame.

Figure 4A illustrates a full (n=1) transmission at 2 (m=2) rate frame with two (m/n=2/1) time repetition. Figures 4B-4D illustrate 2 transmission (n=2) for 2 (m=2) rate frame, 1/4 (m=4) rate frame and 1/8 (m=8) rate frame. As shown in Figure 4B, the 2 rate frame is transmitted without repetition (m/n=1). In Figure 4C, the 1/4 rate frame is transmitted with only two (m/n=4/2=2) times repetition at 2 (n/m=2/4) times power level x of the full rate frame. The 1/8 rate frame is transmitted only four (m/n=8/2) times repetition at 1/4 (n/m=2/8) times power level x (Figure 4D). Figure 4E illustrates 1/4 (n=4) transmission at 1/4 (m=4) rate frame without repetition (m/n=4/4) at the power level of the full rate frame.

As shown in Figs. 1B and 1C illustrating respective transmission timing diagrams for the half rate and quarter rate in the conventional method, data of the half rate and the quarter rate are, respectively, repeated in two subframe units and in four subframe units, and the transmission power level is controlled by dividing the full rate power by the repeat times. As shown in Figs. 4C and 4E, the repeat times of the subframe is not set to a result obtained by dividing full rate into sub rate, and the power level of the transmitting period is set to a result obtained by dividing the full rate power level into the subframe repeat times,

instead of reducing or removing the repeat times.

As shown in Figure 1C, the transmission is made through the four times repetition with an energy per symbol of x/4 in the conventional method. In the preferred embodiment, the transmission at 1/4 rate is made through the two times repetition with an energy per symbol of x/2 (Figure 4C), or is made without repetition with energy per symbol of x (Figure 4E) by the digital modulator 202. If the transmission is made without reduction of the repeat times of the subframe or the repetition as mentioned above, a period where the signal is not transmitted can be made within the frame.

The gain controller 203 reconstructs the modulated frame as the transmission frame by inserting the non-transmitting period including a terminal searching period into the modulated frame. Then, the aforesaid frame is reconstructed as the transmission frame which has the same energy transmission level E and transmitting periods as shown in Figs. 4C and 4E according to the repeat times of the frame.

At this time, the period where the transmission frame is not transmitted may be inserted into the front part of the repeated frame period or into the rear part thereof through the variable rate limitation method. Since the frame can be reconstructed as one frame having the terminal searching period through at least two times or more repetition according to the size of the energy

transmission level, the length of the frame can be shortened. Further, the non-transmitting period may be inserted into the same transmission frame through the frame repetition according to a control of the energy transmission level.

At this time, the force (n/m)x of the signal in accordance with the transmission bit is obtained by dividing the signal force x of the transmission bit of the full rate frame into the repeat times (m/n), for maintaining the signal quality. The transmitting period of the signal can be set in different random patterns for respective mobile terminals for minimizing a signal interference between terminals different from each other.

If the transmission signal processed in the above-mentioned method is transmitted by the RF transmitter 201, the RF receiver 102 of the receiving portion 100 receives the radio signal.

Thereafter, the digital demodulator 101 demodulates the radio signal into the signal, as shown in Figs. 4C and 4E. The mobile terminal varies a frequency of the frequency mixer 103 during the period where the signal is not transmitted into the frame through the frequency mixer 103 and the peripheral device (not shown) (hereinafter, which is referred to a frequency searching period), and then searches the base station signal of the different frequency, thereby being capable of performing the inter-frequency mobile-assisted handoff.

When sequences repetition and puncturing are used for rate

matching, transmission limitation is applied as described below.

Generally, for I/n(n=2,4,8)length transmission, code sequence of I/m(m=1,2,4,8)rate frame is repeated I/n times(including original sequence) and transmitted with n/m times symbl energy of the full rate frame. Rate limitation is not used to generate non-full rate frame.

When symbol repetition, sequence repetition, and puncturing are used for rate matching, transmission limitation is applied as described below. Generally, for I/n(n=2,4,8)length transmission, of I/m(m≥n)rate frame, only I/n portion of repeated modulation symbols is transmitted to generate the same non-transmitting period as forward fundamental channel frame with TBD times modulation symbol energy of the full rate frame. For k times plus partial sequence repetition, in general, only I/n(where n≤k)length transmission is possible. In order to generate the frame with less than n times repetition, rate limitation may be used.

Pilot control channel frame are not transmitted during the non-transmission interval. Supplemental channel frame is not transmitted for the duration of the frame with transmission limitation.

Figure 4F is an example of the present invention when the total repetition time of the transmission frame is not an integer number. As shown, the original transmission frame is repeated twice in entirely while partially repeated three times, which is

referred to as m (m=2 in this instance) plus partial repetition. If 1/2 of a whole transmission frame is transmitted, the 1/2 transmission frame has a repetition time of "1 plus partial repetition". The energy of the transmission symbol should be intensified compared to the original signal. In this instance, the intensity of the signal is increased inversely proportional to a transmission interval reduced compared to the whole transmission frame, or each symbol having a different repetition time is individually increased inversely proportional to a reduced repetition time.

Figure 4G illustrates the repetition time, where the original transmission frame comprises "1 plus a partial repetition". In this instance, the transmission interval is limited to 1/2 of the whole interval, and the repetition time become "zero plus a partial repetition" to allow a portion of the whole frame to be transmitted. Even under this circumstance, it is possible to recover the signals at the receiving terminal by using a proper forward error correction technique.

Figure 4H illustrate an original transmission frame has a repetition of one. The transmission of such original frame is similar to the above embodiments. this embodiment enables a portion of the whole frame to be transmitted if the transmission interval is limited.

However, the mobile terminal does not know the time and period

of a frequency searching period. This problem can be solved by sending information indicating the time when the frequency searching period is generated from the base station to the mobile terminal. The frequency searching period may periodically be generated in a discontinuous form, and/or may be periodically or continuously during a given period.

A supplemental channel is not transmitted during the frame with the transmission limitation. The transmission limitation can be differently applied to reverse fundamental channel for a target base station's synchronization with the mobile terminal during the inter-frequency handoff. The mobile terminal transmits synchronization sequence to other base station with a different frequency during the "off" portion of the frame instead of the transmission gate-off. In an alternative scheme, IS-95 fundamental channel frame is squeezed into a shorter frame with reduced repetition, maintaining the total code channel power, using an additional or supplemental code channel.

For transmission positioning assignment, a starting position of the transmitted symbols for each user may be randomized by a user long code to minimize the intra-cell interference. For intensive frequency scanning and synchronization, the transmission limitation can be assigned for continuous or successive frames of some interval. For 1/n (n=2,4,8) continuous or successive transmission limitation, the starting position of the transmitted

symbols are staggered by 1/n frame time in each 20ms frame. If there is no part of the frame to be staggered, the starting position is the beginning of the frame. Such implementation minimizes guard time overhead for frequency switching and PN resynchronization.

As shown in Figs. 5A to 5H illustrating the continuous frequency searching period, the frequency searching period is enlarged as the length of the frame by modularly increasing the starting point of the frequency searching period in the continuous frame in a length unit of the transmitting period. For example, in case that the random pattern is the quarter rate and the repeat times is one (Figs. 5E and 5F), the starting point of the frequency searching period of the present frame is the first period in four transmitting periods, is allocated to the second transmitting period in the next frame. Further, the starting point of the frequency searching period is allocated differently and randomly for respective mobile terminals, thereby being capable of statistically distributing the interference between the mobile terminals.

As the above-mentioned transmitting method is applied to the reverse link or channel transmitted from the terminal to the base station, the terminal uses an empty period to transmit the signal of the different frequency. Accordingly, the base station of the different frequency can previously be synchronized with the signal

of the frequency for the handoff.

On the other hand, in case of Fig. 4A, since the frequency searching period can not be made for the full rate, the frequency searching period can be inserted by limiting the rate of a data encoder as a vocoder, if needed. Substantially, the CDMA cellular telephone system applies a rate limitation which properly limits the rate of the voice for inserting signaling data into the voice frame during the communication, and the deterioration of the tone quality due to this is negligible.

As discussed previously, a method for providing inter-frequency handoff in the CDMA cellular telephone system of the present invention has an effect capable of maintaining high communication quality by rapidly establishing an inter-frequency handoff as the mobile terminal searches a frequency of the different base station.

The method in accordance with the preferred embodiment fully enhances inter-frequency handoff capability of IS-95 compatible system with minimum changes of the physical layer, e.g., there is no need for channel structure modifications of the compressed mode. There is no perceptible voice quality degradation even in the worst case scenario that requires intensive frequency scanning. Moreover, power control and time tracking are well maintained, compared to discarding of an entire frame for inter-frequency handoff.

It will be apparent to those skilled in the art that various modifications and variations can be made in a method and system for providing an inter-frequency handoff in a code division multiple access cellular telephone system of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

The foregoing embodiments are merely exemplary and are not to be construed as limiting the present invention. The present teaching can be readily applied to other types of apparatuses. The description of the present invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art.

CLAIMS:

1. A method of performing a handoff in a telephone system comprising the steps of:

modulating a frequency band to a prescribed energy transmission level of a frame unit by controlling repeat times of a symbol;

inserting a searching period into the modulated frame to reconstruct the modulated frame as a transmission frame; and

searching a frequency information of a station with the transmission frame to perform a handoff.

2. The method of claim 1, wherein said modulating step further comprises the step of controlling an energy per information bit of the symbol.

3. The method of claim 1, wherein said modulating step further comprises the step of controlling a position of the symbol.

4. The method of claim 1, further comprising the step of controlling a form of a transmitting period with a variable rate characteristic of the transmission frame.

5. The method of claim 1, wherein the repeat time is an integer number of repetitions.

6. The method of claim 1, wherein the repeat time includes a partial number of repetitions.

7. The method of claim 2, wherein the modulating step further comprises the step of controlling a position of the symbol.

8. The method of claim 7, further comprising the step of controlling a form of a transmitting period with a variable rate characteristic of the transmission frame.

9. The method of claim 8, wherein said modulating step further comprises the step of controlling an energy per information bit of the symbol.

10. A method for providing a handoff in a telephone system comprising the steps of:

modulating a frequency band into a modulated frame having a repeated frame period by varying an energy transmission level based on a full rate frame;

forming a non-transmitting period to the modulated frame and reconstructing a repeat transmission frame by controlling a number of repetition of the energy transmission level; and

searching frequency information of a peripheral station with the transmission frame to perform a handoff and transmitting the

searched information to a transmitter of a base station.

11. The method of claim 10, wherein a non-transmitting period is inserted into the transmission frame by controlling the number of repetition based on the energy transmission level.

12. The method of claim 10, wherein said non-transmitting period of said transmission frame is inserted in a random pattern through a variable rate limitation method.

13. The method of claim 12, wherein said random pattern is any one of a half rate, a quarter rate and an eighth rate.

14. The method of claim 10, wherein said non-transmitting period of said transmission frame is a frequency searching period.

15. The method of claim 14, wherein a starting point of said frequency searching period is modularly increased in a length unit of a transmitting period.

16. The method of claim 10, wherein the non-transmitting period is formed based on a form of a transmitting period with a variable rate characteristic.

17. The method of claim 10, wherein the number of repetions is an integer.

18. The method of claim 10, wherein the number of repetions includes a partial number of repetitions.

19. A method for providing a handoff in a telephone system comprising the steps of:

forming a non-transmitting period in a transmission frame by controlling a number of repetitions of a transmission symbol in a frame and at least one of a position and form of a transmitting period with a variable rate characteristic of the transmission frame;

controlling an energy transmission level of the transmission symbol by an inverse proportion of the number of repetitions; and

searching a base station signal of a different frequency during the non-transmitting period; or transmitting a signal to the base station of the different frequency, by a mobile terminal.

20. The method of claim 19, wherein said non-transmitting period of said transmission frame is a frequency searching period.

21. The method of claim 19, wherein the energy transmission level of the transmission symbol is determined by dividing a full rate

energy level by the number of repetitions.

22. The method of claim 21, wherein the number of repetitions is an integer.

23. The method of claim 21, wherein the number of repetitions includes a partial number of repetitions.

24. A telephone system comprising:

a station that modulates a frequency band into a transmission frame having an energy level based on an inverse proportion of a number of repetitions of a transmission symbol, and at least one of a position and form of a transmitting period with a variable rate characteristic of the transmission frame, said station forming a non-transmitting period based on the number of repetitions as a searching period; and

a terminal that searches frequency information during the searching period and transmits the searched frequency information to said station.

25. The telephone system of claim 24, wherein said station comprise:

a modulator that modulates the frequency band to the energy level of the transmission frame;

a gain controller that inserts the non-transmitting period; and

a transmitter coupled to said gain controller to transmit the transmission frame.

26. The telephone system of claim 25, wherein the number of repetions is an integer.

27. The telephone system of claim 25, wherein the number of repetions includes a partial number of repetitions.

28. The telephone system of claim 24, wherein said terminal comprises:

a receiver that receives the transmission frame;

a demodulator that demodulates the transmission frame;

a mixer that varies a frequency during the non-transmitting period and searches the frequency information of a station having a different frequency to perform a handoff.

29. A method of providing a handoff in a telephone system substantially as herein described, with reference to the accompanying Figures.

30. A telephone system substantially as herein described, with reference to the accompanying Figures.

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Application No: GB 9824283.7 **Examiner:** Nigel Hall
Claims searched: all **Date of search:** 23 February 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): H4L (LDSHE, LDSHS, LDSHX, LDSU, LFM); H4M (MP)

Int Cl (Ed.6): HO4Q 7/38; H04J 3/12

Other: Online: WPI, EPODOC, PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X,Y	GB 2297460 A	(MOTOROLA) see p.5 lines 16-26, claim 10	1,10,19,24 at least
Y	WO 97/40593 A1	(ERICSSON) see whole document	,,

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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